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with surface temperatures but half as much. But the light emission per unit area is much less for red stars than for blue. The obvious conclusion is, therefore, that in all these clusters, and probably in all globular clusters, the volumes of the bright red stars are very great in comparison with the stars that are fainter and relatively blue.

[1] These PROCEEDINGS, **2**, 12 (1916).
[2] *Mt. Wilson Contr.*, No. 116, Sections IV and VIII (1916).
[3] *Publ. Astr. Soc. Pac.*, No. 163, April 1916.

THE EFFECT OF AN ELECTRIC FIELD ON THE LINES OF LITHIUM AND CALCIUM

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During the last three years a great deal of work has been done on the electric decomposition of spectral lines. Stark[1] examined the effect in canal rays, subjected to a strong auxiliary field, and Lo Surdo[2] photographed the light immediately in front of the cathode, where the luminosity of the negative glow and the sudden fall of potential fulfilled the required conditions. Hydrogen and helium have been examined by both methods and Stark has investigated the transverse effects for lithium, mercury, and a number of other elements. So far, only H, He, and Li have shown large effects, and the results found for H and He by the two methods differ considerably.

In spite of the great number of data accumulated by Stark, Lo Surdo, and their co-workers since the discovery of the electric effect, the work in this important field is only begun and offers great opportunities for further work. The apparatus used by Stark is very difficult to construct and needs the constant services of a skilled glass blower. Moreover, Stark has already examined most of the more promising elements. The method of Lo Surdo is very simple and has been applied, so far, only to hydrogen and helium. A survey of a number of elements was therefore made with the Lo Surdo form of apparatus, under low dispersion, and in the course of the work some new and interesting results were obtained with calcium and lithium.

A full description of the apparatus used will be published in the *Astrophysical Journal*, but it was essentially of the Lo Surdo form. The tube had an internal diameter of 6 mm. and a length of 20 cm. The discharge from an induction coil was used, rectified by a valve tube. The spectrum was photographed with a three prism, quartz and ultra-

violet glass, spectroscope which gave a dispersion of 1 mm. = 18 A. U. at Hγ, and 1 mm. = 12 A. U. at the H and K lines.

Lithium and calcium were examined, both for the longitudinal and transverse effects, and the results are given below in tables I and II. With both elements the spectra were obtained by covering the cathode with a thin layer of the chloride, which gave the characteristic spectrum of the metal under the bombardment of the anode rays. The tubes were filled with hydrogen, and the field strength was determined for every plate by measuring the separation of the outer components of Hγ and comparing it with Stark's results. The field strength was about 25,000 volts per cm. close to the cathode. In the following tables the numbers marked + indicate components to the red, − to the violet.

TABLE I

LITHIUM.

Transverse effect for 20,000 volts per centimeter

λ IN A	COMPONENTS POLAR PARALLEL	INT.	COMPONENT POLAR PERPENDICULAR	INT.	REMARKS
4602.37	+1.00	8	+0.48	8	
	−2.48	6	−2.00	6	
4132.93	+2.26	2	+1.78	2	
	−0.18	5	−0.18	5	Unpolarized
	−3.10	1	−2.24	1	
Longitudinal effect for 20,000 volts per centimeter					
4602.37	+0.57	8	+0.34	6	
	−2.01	6	−1.53	3	
4132.93	+1.16	1	+0.77	1	
	−0.26	5	−0.26	5	Unpolarized
	−1.99	0	−1.50	0	

TABLE II

CALCIUM H AND K

Transverse effect for 20,000 volts per centimeter

λ IN A	COMPONENTS POLAR PARALLEL	INT.	COMPONENTS POLAR PERPENDICULAR	INT.	REMARKS
3968.63	+0.22	6	+0.16	6	Unpolarized
	−0.86	2	−0.74	2	
3933.83	+0.22	9	+0.22	9	Unpolarized
	−0.92	3	−0.74	3	
Longitudinal effect for 20,000 volts per centimeter					
3968.63	+1.27	3	+1.23	3	Unpolarized
	+0.01	8	−0.02	8	Unpolarized
	−1.17	0	−1.11	0	Unpolarized
3933.83	+1.42	4	+1.38	4	Unpolarized
	+0.06	9	−0.02	9	Unpolarized
	−1.30	1	−1.26	1	Unpolarized

It is interesting to find that the lithium lines $\lambda 4602$ and $\lambda 4132$ show polarized components in the longitudinal effect. The longitudinal effects in hydrogen and helium, the only ones investigated up to this time, had given unpolarized components.

Previously, only the diffuse series of elements had shown large electric effects which makes the calcium results most unexpected. H and K belong to a principle pair series and the lines of the diffuse series at $\lambda\lambda 4457$, 4435, and 4425 show no effect at all, under low dispersion.

A full account of this investigation will be published shortly in the *Astrophysical Journal.*

[1] J. Stark, *Ann. Physik,* **43**, 965 (1914); J. Stark and G. Wendt, *Ibid.*, **43**, 983 (1914) J. Stark and H. Kirschbaum, *Ibid.*, **43**, 991 and 1017 (1914); J. Stark, *Ibid,* **48**, 193 (1915).

[2] A. Lo Surdo, *Roma, Rend. Acc. Linci,* **23**, 1st. sem., 82, 143, 252, 326 (1914).

A PROOF OF WHITE'S PORISM

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The interesting theorem of Professor White[1] to the effect that *if two cubic curves in space admit a configuration* Δ_7—i.e., *seven points of the one and seven planes of the other such that each of the points is on three of the planes and each of the planes is on three of the points—then they admit* ∞^1 *such configurations* furnishes perhaps the only important generalization of the Poncelet polygons.[2] Analytically expressed the theorem states that if for a (3, 3) form $F(\lambda,\mu)$ there exists a set of seven parameters λ and seven parameters μ such that $F = 0$ for each λ together with three μ's and for each μ together with three λ's, then there exists ∞^1 such sets Δ_7.

The published proof of this theorem fails owing to an error of enumeration.[3] This error, originally overlooked by Professor White and myself, was noted subsequently by him. That however the theorem itself is true can be shown as follows.

Let $G(\lambda_1, \lambda_2) = 0$ be the condition that distinct values λ_1, λ_2 determine in $F(\lambda, \mu) = 0$ the same value of μ. Then G is a symmetrical (6, 6) form. If $F(\lambda, \mu)$ has a Δ_7, the seven λ's constitute an involutorial set of G, i.e., a set such that any two of the λ's satisfy $G = 0$. Conversely if G has an involutorial set, then $F(\lambda, \mu)$ has a Δ_7. For if λ_1 and any one of $\lambda_2, \ldots, \lambda_7$ satisfy $G = 0$ then, since λ_1 can determine in $F = 0$ at most three μ's, λ_1 must be associated with three pairs of the remaining λ's in such a way that each pair determines with λ_1 a common value μ.